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REPORT ON THE MISSION TO TIMOR-LESTE (EAST TIMOR)

8-17 December 2003

ASPIDIOTUS DESTRUCTOR **OUTBREAKS ON** ***COCOS NUCIFERA*** **IN BAUCAU DISTRICT**

Dr Laurence Ollivier, coconut entomologist

Dr Xavier Bonneau, coconut agronomist

CP SIC No.1718
March 2004

CONTENT

MISSION SCHEDULE

Monday 8th December 2003

Flight Montpellier – Paris by AF 7681
Flight Paris – Singapore by SQ 333

Tuesday 9th December 2003

Arrival in Singapore
Flight Singapore-Denpasar by SQ 142.
Overnight in Denpasar.

Wednesday 10th December 2003

Morning

Flight Denpasar-Dili by MZ 8480

Met by Americo Brito (MAFF) at the airport in Dili.

Afternoon

Meeting with Lourenço Fontes, Director of Research and Extension (MAFF).

Meeting at the USAID office with Nicholas Hobgood, Chief of Party (USAID), Mrs Cristina Freitas, Grants Manager (USAID), Mr Osorio Correia (USAID), Mr Lourenço Fontes (MAFF).

Meeting at the Ministry of Agriculture, Forestry and Fisheries with Mr Cesar Jose Da Cruz, Director of Agriculture.

Overnight at Turismo Hotel in Dili.

Thursday 11th December 2003

Morning

Travel Dili-Baucau by Ministry vehicle with Americo Brito from MAFF, who accompanied us throughout our stay.
Arrival in Baucau and check-in at Hotel Pousada.
Meeting with Mr Olivier Langoisseux, mission coordinator IRFED.

Afternoon

Meeting at the MAFF Baucau District office chaired by Mr Abilio Ornai, Head of Agriculture for Baucau District.
Meeting with Mrs Brigitte S.-Pödborny, Institutional Development (GTZ)
Tour of coconut plantings at Baucau (Lamigua) and surrounding area (sample collecting).
Visit to the ladybird mass rearing laboratory at Triloka.
Estimation of ladybird multiplication.

Assessment of rearing conditions.
Proposals for optimizing ladybird multiplication conditions.
Collection of Pseudococcidae in the rearing unit.
Collection of dead adult ladybirds in the rearing unit, and those displaying abnormal wing development.

Visit north of the town of Baucau as far as the sea. Evaluation of pest dispersal since March 2002. Sample collecting at 4 distinct sites.

Friday 12th December 2003

Morning

Trip to Viqueque by car via Venilale and Ossu. At Viqueque, tour of the Raitahu plantation. Collection of *A. destructor* samples.
Estimation of the geographical dispersal of *Aspidiotus destructor* since March 2002 south of Baucau.
Stop-over at the Naeboruk site. Observation and collection of *A. destructor*.
Return in the afternoon to Baucau.

Afternoon

Tour of Baucau.
Identification of candidate palms to estimate *A. destructor* populations before the first releases. Demonstration of the technique in the field. Drafting the experimental protocol.

Identification of sites for *Chilocorus politus* releases in the wild.

Discussions

Saturday 13th December 2003

Trip to Com by car.
Assessment of the situation at Com
Taking of pest and predator samples.
Observations with local people.

Various stop-overs on the Com-Baucau road: Sicara, Irara, Raumoco, Seisal, Buruma.

Return to the Baucau laboratory to prepare the predator samples.
Appetency testing on infected coconut leaflets.

Return to the hotel.

Interview with the Timor Post.

Sunday 14th December 2003

Morning

Debriefing with A. Brito and Alvaro in Baucau.

Afternoon

Baucau-Dili by road.
Check-in at the Turismo hotel.

Monday 15th December 2003

Morning

Appointment with Mr G.Colombo at the European Commission office in Dili.

Appointment at MAFF with the Minister of Agriculture, Forestry and Fisheries, Estanislau Aleixo da Silva. Meeting cancelled as the Minister was called out urgently.

Debriefing at the USAID office with Mr. Nicholas Hobgood, Cristina Freitas, Alvaro, Americo Brito, Lourenço Fontes.

Afternoon

Flight Dili-Denpasar by MZ 8490.
Flight Denpasar-Jakarta by GA 413.

Tuesday 16th December 2003

Morning

CIRAD office in Jakarta
Meeting with Mr J.G. Bertault
Meeting with Dr. Andi Trisyono, UGM Yogyakarta, Indonesia.

Afternoon

Meeting at the French Embassy in Jakarta with Mrs Annie Evrard, Mr Yann Brault, Mr Christophe Horvath and Mr J.G. Bertault.

Flight Jakarta-Singapore by SQ161
Flight Singapore-Paris by SQ 334

Wednesday 17th December 2003

Flight Paris-Montpellier by AF 7680

PEOPLE MET

- Nicholas Hobgood, USAID Chief of Party, Program Support Initiative, Dili, Timor–Leste.
- Cristina Freitas, USAID Grants Manager, Program Support Initiative Dili, Timor–Leste.
- Guglielmo Colombo, European Commission, Representative Office in Timor-Leste, Dili.
- Günter Kohl, German Technical Cooperation, Food Security Programme, Baucau and Viqueque, Baucau, Timor-Leste.
- Lourenço Fontes, Director Research and Extension. MAFF.
- Americo Brito. MAFF officer.
- Alvaro Pascoal Da Costa Alves, Triloka laboratory technician, Baucau.
- Hercio Angelo Balarmino de Araujo,Triloka laboratory technician, Baucau.
- Brigitte S. -Podborny, German Technical Cooperation, Food Security Programme, Baucau and Viqueque. Baucau, Timor-Leste
- Annie Evrard, Scientific and Technical Cooperation Attachée, French Embassy in Indonesia.
- Yann Brault, Mission Coordinator, Scientific Cooperation, French Embassy in Indonesia.
- Jean-Guy Bertault, CIRAD Regional Director for insular Southeast Asia, Jakarta, Indonesia.
- Christophe Horvath, European Union, Programme Adviser, Jakarta, Indonesia.
- Andi Trisyono, Entomologist, Gadjah Mada University, Yogyakarta, Indonesia.

ACKNOWLEDGEMENTS

We should like to thank USAID managers, Mr Hobgood and Mrs Freitas, who perfectly coordinated this mission in conjunction with Mr L. Fontes from MAFF in Dili. Without their support, the launch of the biological control project would have been jeopardized.

We should like to thank A. Brito and Alvaro Alves for accompanying us throughout the mission and for providing useful data for assessing the current situation in the field and at the Triloka laboratory where *C. politus* rearing was launched at the end of 2003.

Our thanks to Mr G. Colombo from the European Commission and Mr G. Kohl for seeing us and taking into consideration the project under way on *Aspidiotus destructor* control in Timor-Leste.

Lastly, we are particularly grateful to Mr J.G. Bertault who ensured good communications with the French Embassy regarding the way CIRAD activities on this project were progressing. We should like to thank Mrs Evrard and her colleagues for seeing us and taking an interest in the CIRAD activities under way on this subject, since her predecessors had recognized the merits of launching action in March 2002.

Many thanks also to P. Biggins for translating this report and to V. Lesage and V. Rieucau for its final formatting and production.

Abbreviations:

CIRAD	Centre de coopération internationale en recherche agronomique pour le développement
GTZ	Gesellschaft für Technische Zusammenarbeit (German technical Cooperation)
MAFF	Ministry of Agriculture, Forestry and Fisheries
UGM	Universitas Gadjah Mada (Yogyakarta, Indonesia)
USAID	United States Agency for International Development

SUMMARY

During our March 2002 mission funded by the French Ministry of Foreign Affairs, we have :

1) Identified the pest responsible for coconut decay in Baucau: the scale insect *Aspidiotus destructor*.

2) Proposed a biological control method consisting in importing a species of predatory ladybird, to rear it locally in Baucau and release it in infested coconut plantations.

In July 2003, after CIRAD contacts with the Indonesian University of Gadjah Mada in Yogyakarta (Dr. Andi Trisyono), two Timorese representatives from MAFF took a course at the entomology faculty of that university. They selected a local species of ladybird, *Chilocorus politus*, known for its effectiveness against *A. destructor*, and were trained in rearing techniques.

In September 2003, 46 *C. politus* adults were imported from Yogyakarta to Timor–Leste, 38 of which arrived in good condition at the Triloka laboratory near Baucau.

Our December 2003 mission, commissioned by the Timorese MAFF and funded by USAID / DAI in Dili, consisted in:

1) Checking that the Triloka laboratory complied with rearing standards.

2) Preparing ladybird releases.

3) Assessing the degree of damage caused by the pest in Baucau and checking for its possible presence in two coconut growing zones: Viqueque and Com.

Regarding point 1), advice is given for:

- Improving the building layout to create a stable microclimate appropriate for ladybird development.
- Improving the production of *A. destructor* rearing media (pumpkins).
- Organizing the different stages of *C. politus* rearing to avoid mixing the successive larval instars and generations.

Regarding point 2), 8 release sites were chosen in Baucau, along with 4 control sites without releases. At each site made up of 10 coconut palms, pest population trends will be regularly monitored. Depending on ladybird production levels at the Triloka laboratory, the first releases are scheduled for April 2004, at the beginning of the dry season.

Regarding point 3), we noted the considerable spread of the pest, and of palm deaths in and around the town of Baucau between March 2002 and December 2003. We also identified some *A. destructor* foci in Viqueque district, but no outbreaks for the moment. Lastly, we identified some *A. destructor* foci in the coastal villages between Baucau and Com. At the port of Com, a local species of ladybird, *Pullus* sp., was identified that is apparently a predator of *A. destructor*. Its efficacy should be tested at Triloka.

INTRODUCTION

At the end of 2001, the CIRAD delegate in Jakarta, G. de Taffin, was alerted by the provisional UN administration to the existence of decay in the coconut plantings around the town of Baucau in Timor-Leste (de Taffin, 2001). Following a fact–finding mission in December 2001, where he suspected damage caused by the pest *Aspidiotus destructor*, Dr. L. Ollivier and Dr. X. Bonneau carried out a mission in March 2002, with funding from the French Ministry of Foreign Affairs, to identify the pest, estimate the damage and propose a control strategy against the insect. After formally identifying the cause of the decay (facilitated by the fact that the same pest was also causing considerable damage to coconut palms on the Indonesian island of Flores not far from Timor), the solution adopted was to identify and import predatory ladybirds (*Chilocorus politus*) from Indonesia, where the pest exists and is naturally controlled. Lastly, it was proposed to rear them in a laboratory near the infested zone and release them on mass.
Through our contacts in Indonesia, Dr. Andi Trisyono from the University of Gajah Madah in Yogyakarta agreed to take two Timorese trainees. The purpose of the course, which took place in July 2003, was for the trainees to acquire essential knowledge for successfully implementing a biological control programme, in particular respecting the various stages involved in preparing exports of the predatory ladybird species (*Chilocorus politus),* and to give them practical training in rearing techniques.
The mission reported on here took place 22 months after the initial mission, whereas in the report drafted in April 2002 (Ollivier and Bonneau, 2002), we mentioned the urgency with which action needed to be taken to control the damage caused by *A. destructor*, which was already judged to be serious. Although the *A. destructor* outbreak observed is a consequence of climatic factors propitious to the development of the insect, it is also due to the absence of efficient natural enemies.
During our mission in March 2002, we did not identify any natural enemies capable of controlling the level of this pest's population below an economically acceptable threshold.
In addition, given the urban and village location of the damage, any treatment by insecticides had been ruled out (Ollivier and Bonneau, 2002). For unknown reasons, the scale insects are more common on coconut palms near dwellings (Kalshoven, 1981). It was therefore proposed that a biological control method should be used which has already been clearly described in the literature, and which has been tried and tested in other countries (Kinawy, 1991; Ollivier and Bonneau, 2002).

The terms of reference for this mission consisted in:

- Assessing *A. destructor* population levels before releasing *Chilocorus politus* ladybirds at selected sites (counting under a binocular loupe).
- Assessing the level of infestation along the north coast between Baucau and Com, and Viqueque in the Southeast.
- Inspecting the basic quarantine structure (the Baucau laboratory's compliance with usual standards).
- Inspecting *A. destructor* rearing, and mass rearing of the ladybird *C. politus* under laboratory conditions (photoperiod, temperature, humidity, etc.).
- Selecting sites to release *C. politus* in the field. Defining release conditions.
- Preparing *C. politus* releases (depending on successful *C. politus* production in the laboratory).
- Discussing the protocol for assessing *C. politus* acclimatization in the wild.

This report presents our observations during the mission and recommendations that will enable the local team to implement a control programme.

1. PHYTOSANITARY STATUS OF THE COCONUT PLANTATIONS

Our mission focused on Baucau District as far as the port of Com, and on Viqueque District (Ollivier and Bonneau, 2002).

1. Assessment of the coconut phytosanitary situation at Baucau (Baucau District)

1.1. Findings

Since our visit in March 2002, we found that damage caused by *Aspidiotus destructor* Signoret 1869 (Hemiptera, Coccoidea, Diaspididae) either side of the focus was very severe and dead coconut palms, which were seen in 2002, were found again.
In addition, *A. destructor* outbreaks on coconut palms extend beyond Baucau in a radius estimated at 5 km to the south of Baucau and reach the coast north of Baucau, as we report below.

Following our recommendations, action was launched in and around the town of Baucau to limit and physically control the spread of *Aspidiotus destructor* (Ollivier and Bonneau, 2002). It consists in cutting coconut fronds displaying *A. destructor* attacks and burning them to limit the population level and prevent the contamination of unaffected coconut palms.
This control measure is accepted by some farmers for payment of US$ 25 cents to treat 2 young palms or 1 mature palm. Other farmers refuse to apply the method proposed and encouraged by the MAFF services.
Unfortunately, given the extent of the damage, this measure is not systematically applied and we only saw a worsening in the phytosanitary condition of the coconut palms at Baucau (Figures 1 and 2).

Fig. 1: Worsening damage at Baucau

Fig. 2: Damage on old coconut palms at Baucau

Moreover, the observations made in December 2003 below Baucau, to the North of the town towards the coastal zone (250 m above sea level) revealed a very different landscape from the one seen in March 2002. Indeed, whilst the coconut palms appeared to be perfectly healthy, without any obvious scale insect damage on the surface of the fronds at sea level, damage had spread spectacularly in December 2003 (Figures 3, 4 and 5).

Fig. 3: Situation between Baucau and the coast in March 2002.

Fig. 4: Between Baucau and the coast in December 2003

Fig. 5: Between Baucau and the coast in December 2003

On the journey between Baucau and Viqueque we saw how damage had spread to the South of Baucau, at Builai. The coconut palms have an erect growth habit, suggesting that the lower infected fronds had been subjected to the recommended measure of cutting and burning. The banana plants were also affected (Figures 6 and 7), as we saw on Flores in Indonesia in 2001 (Bonneau, 2001).

Compared to the reference point noted in March 2002, we found that damage had spread 5 km to the South of Baucau (Annex 1). The zone is marked out with yellow discs to the South and East of Baucau.

Comment: Isolated coconut palms would seem to be less attacked and attacks would appear to be worse on palms with red nuts than on palms with green nuts according to our guides. We do not have any data to confirm this observation.

Fig. 6: Banana infested by *A. destructor*

Fig. 7: Underside of a banana leaf infested by *A. destructor*

1.2. Recommendations

Unfortunately, in the Baucau zone, we found the coconut palms to be severely infected and, unlike in 2002, young fronds display serious symptoms of *A. destructor* attacks. Consequently, it seems pointless continuing the control measure of cutting and destroying affected lower fronds. It is only effective when damage is limited to the lower fronds of the palm.
However, this measure must be encouraged in infestation borderline zones, on the pest's advancing front to the South of Baucau and in zones that are still only slightly affected (Annex 1).
When *A. destructor* reaches a spear, as seen right in the centre of Baucau and increasingly to the North of the town, this measure has become pointless. If more than ¾ of fronds are cut per palm per year, the survival of the palm is endangered.
After acceptable pruning, an application of nitrogen is recommended to stimulate a resumption of palm growth.

2. Assessment of the coconut phytosanitary situation at Com (Baucau District)

2.1. Findings

Leaving Baucau by the Com road, less damage can be seen in the Kelapa zone (indicated by a blue spot on the map) (Annex 2). Starting from the point indicated by a yellow disc on the map to the East of Baucau, there are no more coconut palms, but lontar palms. It is from that zone that infestation stops.

On arriving in Com, we examined the same coconut palms as we examined in March 2002. *A. destructor* was found on young coconut palms planted along the shoreline (Figures 8 and 9).

Fig. 8: Young coconut palms at the port of Com

Fig. 9: Underside of a coconut frond (Uninfected/infected comparison)

Damage was seen to be only slight, and one small black ladybird with very hairy wing cases was found. These small ladybirds were found on neighbouring coconut palms feeding off *A. destructor* (Figures 10 and 11).

Fig. 10: Coccinellidae on *A. destructor* at Com

Leaflet number	**Attack %**	**Number of ladybirds**
1	100	5
2	10	1
3	5	1
4	10	1
5	15	0
6	20	2

Fig. 11: Existence of ladybirds on leaflets of a coconut palm in the port of Com

Samples were taken to confirm the identification of *A. destructor* and the identity of the ladybird.
Some ladybird samples were taken to test their appetency on infected coconut leaflets in the Triloka laboratory.
Either these ladybirds were not present in March 2002, or they went unnoticed.

On the road from Com to Baucau, we stopped at different points to observe coconut palms with an accessible crown (Figure 12).

Location	*A. destructor*	Predator	Host plant
Sicara	+	-	Young coconut palms
Irara (blue disc)	+	-	Young coconut palms
Raumoco village	+	+	10-year-old coconut palms
Seisal	++	+	8-year-old coconut palms
Buruma (near Baucau)	+++	-	Coconut palms, banana plants

Fig. 12: Inspection of coconut palms between Com and Baucau

2.2. Recommendations

To reach Com, we passed through zones without coconut palms, particularly dry zones where the vegetation prevents *A. destructor* from spreading rapidly. This natural barrier formed by such vegetation may provide protection against scale insects spreading from tree to tree (Figure 13).

Fig.13: Vegetation between Baucau and Com

Zones planted with coconut palms should be inspected annually.

3. Assessment of the coconut phytosanitary situation in Viqueque District

3.1. Findings

We had the opportunity to return to the Raitahu plantation which, being located in Viqueque District, is far away from Baucau and separated by a mountainous barrier (Figures 14 and 15). Given its height, this natural barrier does not have any coconut palms likely to create a contamination chain via which the scale insect can spread rapidly.

Fig.14: Viqueque plantation

Fig. 15: Vegetation and relief between Baucau and Viqueque

In March 2002, the samples taken and observations made revealed healthy palms. *A. destructor* was absent from the palms examined, particularly the young palms.
However, in December 2003, although no real damage was found, we did distinctly find *A. destructor* to be present on 2 coconut seedlings about 2 to 3 years old in around 1 ha (Figures 16 and 17).
No natural enemy was found in December 2003.

Figures 16 and 17: Identification of *A. destructor* at Raitahu (Dec. 2003).

In addition to *A. destructor*, we found a few isolated colonies of whiteflies on coconut palms in this young plantation. The samples brought back have been identified. They are *Aleurocanthus spiniferus* Quaintance, 1903 (Streito, pers. com., 2004) (Figure 18).

We found some puparia to be parasitized but could not identify the parasites

Fig. 18: *Aleurocanthus spiniferus* puparia

Severe *Oryctes rhinoceros* damage was seen on these young palms (around twenty palms examined).

Returning towards the actual town of Viqueque, at Naeboruk, we found few or no *A. destructor*. We deduced that the environment is well protected by the mountainous barrier but that human exchanges are a risk that must not be overlooked.

On the Viqueque-Baucau road, we made a few stops in the plain, where we saw 4 to 5-year-old palms along the road with *A. destructor* on the underside of leaflets.

3.2. Recommendations

Given the area planted with coconut palms in Viqueque District, we strongly advise paying special attention to any variation in the existing *A. destructor* population, with regular inspection of the coconut palms (an inspection every 6 months).

II- BIOLOGICAL CONTROL PROGRAMME

Theoretical reminders:
Advantage of biological control:
- eco-friendly,
- relatively cheap in the long term,
- sustainable when it works.

Disadvantage :
- not always appropriate if a pest needs to be eradicated immediately.

Any strictly implemented biological control programme must respect the following stages:

- *Initiation and agreement to declare pest status*

A. destructor is acknowledged as a pest whose density must be reduced to bring its population down to an economically acceptable level. This means identifying the damage and acquiring is biological and ecological data, along with the economic losses it causes.

- *Exploration*

This phase consists in observing and identifying natural enemies likely to limit the development and spread of the pest to unaffected zones.
This phase took place in Timor-Leste and Indonesia following a bibliographical study (Ollivier and Bonneau, 2002).

- *Screening and tests*

The agent collected and selected in Indonesia was tested for its range of hosts, and its appetency and specificity for *A. destructor* were also tested. This stage was carried out in the UGM laboratory.

- *Agreement to introduction in the receiving country*

If the agent is found to be specific, an official request is submitted by Timorese officials via the MAFF to the national quarantine services.

- *Mass rearing and field trials*

Following this agreement, mass rearing of *C. politus* can go ahead.
Releases can then be carried out directly in the field or in cages beforehand.

- *Distribution*

Releases will be carried out by the relevant service of the Agriculture Department.

- *Monitoring and assessment*

C. politus releases will be regularly monitored and will be assessed to estimate the acclimatization of this predator, and especially the impact and dispersal rate of the ladybirds.

1. Knowledge of the pest *Aspidiotus destructor*

The *Aspidiotus destructor* female is capable of laying 90 to 350 eggs.
Its biology and ecology have already been described (Ollivier and Bonneau, 2002).

2. Choice and knowledge of the predator *Chilocorus politus*

2.1. Taxonomy and distribution

The natural range of *Chilocorus politus* Mulsant 1850, Coleoptera Coccinellidae, is in Indo-Malaysia. It is found in Burma and Indonesia and as far as the Philippines. It is also found on Mauritius and on Reunion, where it was introduced in 1937 (Quilici et al, 2003).

2.2. The adult

The adult has short antennae with 8 segments and a slight club with 3 segments (Chazeau, 1974). It is about 5 mm long and yellow to orangey-pale brown in colour. Its colour is uniform without any decorative spots. *C. politus* is found on the coast up to 1 600 m above sea level and prefers the higher zones (Quilici et al, 2003).

An adult can consume 60 *A. destructor* individuals per day, i.e. 7 000 to 9 000 over its life span (Desmier de Chenon, 2001).

The male can be distinguished from the female by the number of abdominal segments on the underside. The male has 6, the female 5, the last segment being posteriorly rounded.

2.3. The larva

The larva can be up to 8 mm long. It is yellow to grey with black spines (Figure 19).

Fig.19: *Chilocorus politus* larva

The larva can consume from 80 to 130 *A. destructor* individuals per day, i.e. 1 200 to 2 000 over its life span (Desmier de Chenon, 2001).

2.4. Development cycle

The *C. politus* female deposits its eggs in groups of 10 to 15 on the underside of coconut leaflets.
The cycle from egg to adult emergence lasts 6 to 7 weeks.
The life span of the adult varies from 3 to 5 months (Figure 20).
A female can lay 400 to 500 eggs.
C. politus is a highly voracious predator.

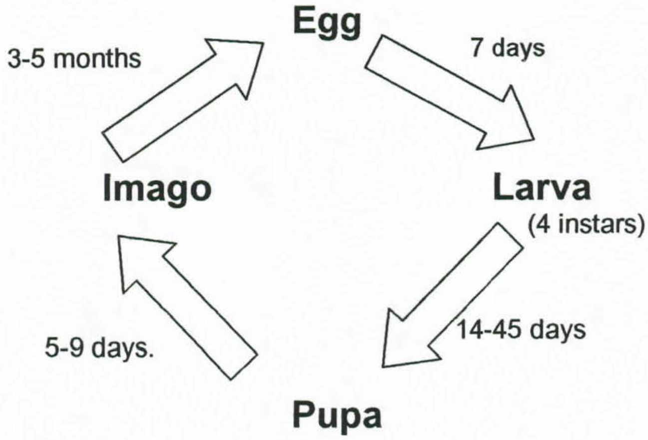


Fig.20: *C. politus* cycle in the UGM laboratory in Yogyakarta (Indonesia)

In all, from larval instar to imago, *C. politus* can consume 8 400 to 11 000 *A. destructor* individuals up to its death (Desmier de Chenon, 2001).

It is worth knowing that during severe infestation as in Baucau, 20 to 30 *A. destructor* individuals can be found per cm^2, and even more than 40, as seen in Baucau in April 2004, i.e. 40 to 60 million per coconut palm, and up to 100 million.

The feeding rate was estimated at UGM (Trysiono, pers. com., 2003):

- 50 *A. destructor* consumed per day per *C. politus* adult
- 60 *A. destructor* consumed per day per *C. politus* larva (varying from 40 to 80 depending on the larval instar).

A. destructor was effectively controlled in Bali by *C. politus* from Java in 1915 (Kalshoven, 1981).

2.5. Origin of *C. politus* and its introduction

Prior to any introduction, A. Brito and L. Fontes benefited from a training course at the University of Gadjah Mada in Yogyakarta, to familiarize themselves with collection and rearing methods, and with the testing of predatory insect specificity on scale insects such as *A. destructor*. This course took place in July 2003 with financial backing from GTZ. Using the knowledge acquired during this course, the future leaders of the *A. destructor* biological control project have been able to organize the introduction of *Chilocorus politus* in Timor-Leste (selection of the infrastructure to receive, rear and test the candidate predator, transport, export permit in Indonesia, import permit in Timor-Leste, etc.), following the necessary recommendations.

2.6. Collection and rearing of the *C. politus* strain in Indonesia

In July 2003, *C. politus* samples were taken in the wild on the island of Java in Indonesia by Dr Andi Trisyono's team from UGM.
The adults were reared in the UGM laboratory in Yogyakarta under determined temperature, humidity and photoperiod conditions (27-28°C, RH 70%, Φ 07.00 a.m., 03.00 p.m.) for several generations to eliminate any risk of pathogens and

superparasitism that might jeopardize *C. politus* development (Trisyono, pers. com., 2003).

2.7. Introduction

At the express request of the Timorese authorities, the healthy *C. politus* strain obtained at UGM was made available to them in September 2003, though the number of individuals available at that time was too small for importing. With support from GTZ, A. Brito made a second trip to UGM on 16 September 2003, in order to introduce **46 *C. politus* adults** in Timor-Leste. The Indonesian quarantine services certified the health status of the exported ladybirds.
The ladybirds prepared at UGM left for Dili on 21 September 2003.
On arriving in Dili on 22 September 2003, there was 17% mortality (i.e. 8 dead ladybirds) due to the transport conditions.
On 23 September, 38 ladybirds were transferred to the Triloka laboratory near the town of Baucau. This laboratory has been assigned to multiplying *C. politus* and testing it on *A. destructor*, the responsible scale insect that exists naturally at Baucau.
For lack of pumpkins as the *A. destructor* host, infected before the ladybirds arrived in Baucau (17 months had gone by since our March 2002 mission report had been submitted), the ladybirds were introduced onto a coconut infected by *A. destructor* on 24 September 2004.

It should be noted that the GTZ Timor office is committed to providing the necessary financial support for the ladybird strain to be maintained at UGM from the time of import to the first releases, i.e. up to April 2004, as a security measure in case ladybird rearing at Triloka fails.

Comment: As we emphasized above, it would have been preferable to import **AT LEAST 100 healthy individuals** (ACIAR, 1991).

3- Mass rearing in the laboratory

C. politus rearing is located in a discreet place so that the multiplication operation does not attract malicious curiosity. Moreover, the predator insects must not be released in the wild before they have been tested for their specificity on *A. destructor*. They need to be multiplied for a certain number of generations under controlled conditions.

3.1. Location, infrastructure and personnel

MAFF has provided a building for this operation, notably a room in which *C. politus* is reared.
The building is at Triloka, near the airport, 15 km from the centre of Baucau. It is a separate building near a few village dwellings. It is surrounded by cultivated gardens and a few healthy young coconut palms.

3.1.1. Observations

Infrastructures:
The site and the external and internal infrastructure of the laboratory appear to be well suited to the operation. The building was renovated for the purpose.
The laboratory has a window facing east (cages) and an entrance door facing west.

The room contains a workbench on which the rearing cages are lined up (Figure 21).

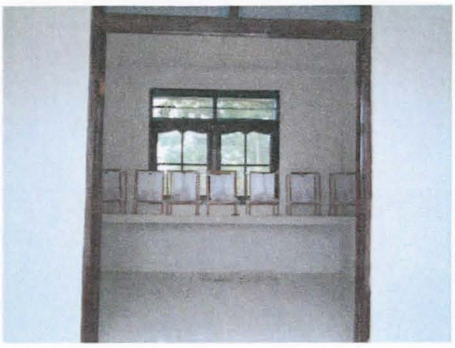


Fig.21: Rearing room entrance – Triloka laboratory

Cages:
The cages are well designed in accordance with the diagram proposed by UGM in July 2003.
The recommended cage dimensions are 300 x 300 x 450 mm so that the ladybirds do not use the available space to fly but rather to feed.
There are 4 large cages and 20 small cages (300 x 300 x 450 mm) (Figure 22).

Fig. 22: *C. politus* rearing cages at the Triloka laboratory

The cage legs are stood in Petri dishes, which should logically be filled with a liquid (water) to prevent ants from entering the cages. We saw many dry dishes.

The cages are not all tightly closed and agents can get in from outside, or the ladybirds can escape.

Laboratory equipment:
The laboratory equipment is not suited to the required uses: there is a very mediocre binocular loupe whose eyepieces are contaminated by fungus and as it is barely possible to identify organisms the size of ladybirds, it certainly will not be possible to count colonies of scale insects in a satisfactory manner, or observe the sex of the ladybirds based on the number of abdominal segments.

Climatic conditions and photoperiod for rearing:
At 03.00 p.m. the room conditions are: min 19°C max 42°C, R.H. 76%. The rearing room climatic data are available for September 2003 (Figures 23 and 24).

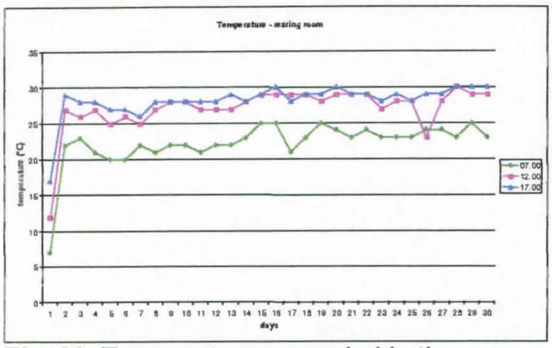


Fig. 23: Temperatures recorded in the rearing room – September 2003.

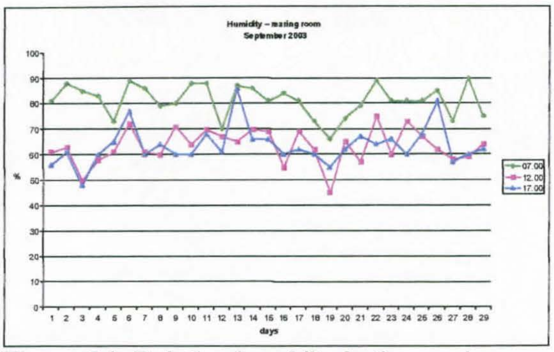


Figure 24: Relative humidity in the rearing room – September 2003.

Depending on the time of day, the cages are directly exposed to sunlight hence to room overheating. There are average temperature variations of 8°C on the same day, and average humidity variations of 20%, yet ladybird rearing is highly sensitive to such variations (Figures 23 and 24).

The cages are subjected to artificial photoperiods that are distinct from natural photoperiods, which could alter the normal cycle of the insects and even seriously disrupt it. The generator comes on at 03.00 a.m. triggering the exterior lighting which can be seen inside the rearing room.
The people on site acknowledge that the generator switches on the outside lighting very irregularly, which is activated in principle for security reasons.

<u>Personnel</u>:
Two technicians and one person in charge of security have been recruited and are based in Baucau.
These people have no experience of insect rearing and, for example, acknowledge that they are unable to distinguish between *C. politus* males and females. They are left to their own devices and cannot strictly control this rearing operation.

3.1.2. Recommendations

• The climatic conditions in the laboratory need to be improved, to ensure a temperature, humidity and photoperiod that are conducive to insect development and reproduction:

- natural photoperiod (no light near the laboratory at night)
- room ventilation
- better temperature and humidity conditions by adapting the window and door: install correctly angled shading to prevent the room from overheating.

We suggest transforming the room by removing the stiles and replacing the windows with thin mosquito netting so that the room is ventilated and less exposed to high temperatures.

The temperature and humidity record sheets in Annex 3 can be used for regular records depending on the time of day.

• If laboratory observations are to be made on living material, the laboratory needs to be equipped with good quality instruments suited to the work in hand: binocular loupe + appropriate lighting, electronic thermometer/hygrometer, flexible tweezers, artist's paintbrushes, etc. (Figure 37, § 6.1 and 6.3).

- For the cages, it is essential to:
  - Top up the level in the Petri dishes in which the cage legs are standing **very often,** so that the cages are not invaded by ants.
  - Close the cages tightly to prevent the ladybirds from getting out but also to prevent access for outside pathogens brought in by people working in the laboratory (bacteria, fungi, etc.).

Lastly, it is recommended that the personnel work under strict conditions and be capable of taking the initiative to successfully complete the rearing operation. Good communication between Baucau and Dili is essential, and we should like the local staff working at the Triloka laboratory to be able to use an e-mail address to communicate with and send data to Dili and let the CIRAD scientists know how the rearing operation is proceeding, so that they can make informed decisions.

3.2. Rearing of the pest *Aspidiotus destructor*

3.2.1. Observations

Production of substitute host plants

Given that it is not feasible to work directly with coconut seedlings, which take too long to produce and take up too much room, substitute host plants are frequently used, such as pumpkins, water melons or potatoes (Sadakathulla, 1993, Desmier de Chenon, 2001, Kreiter, pers. com., 2003).

We noted that there was no continuous pumpkin production locally, or any pumpkin stocks for *Aspidiotus* and *C. politus* rearing.
Neither are there any pumpkins infected by *A. destructor* available, which is contrary to good rearing conditions.

Infection of the host plant

Fragments of coconut leaflets infected by *A. destructor* and supposed to contaminate pumpkins were observed in cages, but we found that the leaflets had often been dried out for too long (Figure 25).

Fig. 25: Contamination of the rearing substrate by *A. destructor*

Contamination by ants or undesirable pathogens

As we pointed out above, we saw cage legs standing in Petri dishes supposed to keep **ants** out that were totally dry. Ants combined with scale insects can prevent ladybirds from becoming established.

The pumpkins placed in the cages were contaminated by a Pseudococcidae **scale insect** of the genus *Dysmicoccus* sp. (Germain, pers. com., 2004) and perhaps of the species *neobrevipes* Beardsley, 1959 (Matile, pers. com., 2004) (Figures 26 and 27).

We know that during rearing, *Pseudococcus cryptus* for example develops faster than *A. destructor* and that they compete with each other (Trisyono, pers. com., 2003).

Fig.26 : Contamination of the substrate by pathogens

Fig. 27: Substrate infected by *Dysmicoccus* sp.

Rearing data

Wishing to consult the data, we found that the data gathered at Baucau were not available and the originals are apparently in Dili, without even a copy at Baucau. We did not have access to the data on this rearing operation at Dili either.

In short, given a lack of *A. destructor* rearing substrate available at all times, and contamination by pathogens, we consider that *A. destructor* rearing is not optimum.

3.2.2. Recommendations

The following points must be considered:

• Improve the supply of pumpkins by growing them on a continuous basis near the laboratory. With mass rearing it is essential to keep abreast of requirements and have pumpkins infected by *A. destructor* available at all times to ensure continuous *C. politus* development.

Note that if it is not possible to have enough pumpkins at the same time, another substrate such as germinated potatoes is a perfect substitute for pumpkin. Indeed, several types of substrate can be used together: pumpkins, water melons and potatoes, though taking care to select healthy substrates that are free of pathogens that might affect *A. destructor* and *C. politus* development.

• To infect the substrates, infected coconut leaflets must be **fixed onto the pumpkins with deeply embedded fine pins**, to ensure effective contact between the underside of the infected leaflets and the surface of the pumpkin, enabling the scale insects to migrate easily from one substrate to the other.

When pumpkins are contaminated by coconut leaflet fragments or fragments of banana leaves contaminated by *A. destructor* in the wild, **use freshly collected leaflets and replace them as soon as they dry out in the cages.**

• *A. destructo*r can be reared in cages and **on shelves** outside the laboratory, since *A. destructor* exists at Baucau, and in an insectarium near the laboratory. We suggest placing *A. destructor* development substrates (pumpkins) on **small wooden stands** (Figure 28).

The room as it is currently designed is not appropriate. We suggest converting it by removing the stiles and replacing the windows with fine mosquito netting, so that the room is ventilated and temperature and humidity conditions are conducive to scale insect development.

Fig. 28: Scale insect rearing (INRA Antibes, France)

3.3. Rearing of the predator *Chilocorus politus*

After *C. politus* is imported, it is necessary in all cases prior to introduction, to rear it for **AT LEAST** one generation in quarantine, to check that the imported strain is free of hyperparasitoids and that the strain is healthy. The advantage offered by this quarantine rearing is that it is also possible to check *C. politus* compatibility with its host *A. destructor* in Timor-Leste.

3.3.1. Observations

C. politus morphological abnormality

When the cages were inspected in the laboratory, we found a certain number of ladybirds with a malformation of the wings and wingcases. The wingcases are soft, not normally sclerified and the two membranous wings are not folded under the wingcases. The behaviour displayed by the insects is generally not very active (Figures 29, and 30).

They have a short life span and lay few eggs (Brito, pers. com., 2003).

Fig. 29 and 30: *C. politus* imagos with abnormal wings and wingcases

Multiplication of *C. politus*

On their arrival, the 38 ladybirds were released into 6 separate cages at a rate of around 7 ladybirds/cage. Nobody could tell us what sex ratio had been introduced, but the first eggs were seen after a week, bearing in mind, for the record, that one female can lay 400 to 500 eggs.

It seemed to us that the number of ladybirds was much smaller than it might have been after 3 months.

The first generation was obtained at the end of October, i.e. 90 adults.

We saw that the different generations of *C. politus* were mixed (first generation and strain of imported origin). No information is provided on the cages.

A count was made on the first day of the visit to Triloka and 84 *C. politus* imagos were recorded.

The people in charge of ladybird rearing cannot tell the two sexes apart.

On 11 December, each cage was inspected. Of the 20 inspected cages containing pumpkin, only 3 looked satisfactory. Nine cages contained all *C. politus* stages. Seven cages had no *C. politus*, 3 cages displayed serious signs of contamination by a Pseudococcidae *D. neobrevipes* mixed with the different *C. politus* development stages, and one cage had pumpkin covered in dried out coconut leaflets.

In short, there is a lack of uniformity in the cages, and a lack of care taken in the mass production of *C. politus*.

The latest data in our possession date from 20 February 2004 (Figure 31).

Date	Larvae	Pupae	Imagos	Total
25/09/203			38	38
12/12/2003	224	19	84	337
19/12/2003			88	434
26/12/2003	45	58	146	249
08/01/2004	15	43	267	325

Fig. 31: *C. politus* rearing data at Triloka

3.3.2. Recommendations

▪ Abnormal morphology and development

Several hypotheses can be put forward:

- Given the small number of imported ladybirds, there may be an inbreeding problem, hence a lack of genotypic heterogeneity. If so, we recommend introducing new individuals into the original breeding population.

- Handling conditions. **UNDER NO CIRCUMSTANCES** should pupae be unhooked, as they are very fragile (Kreiter, pers. com., 2003),
- Inappropriate rearing conditions (temperature, relative humidity, ladybird food) (Kreiter, pers.com., 2003).
  70% RH and 27-28°C are desirable to prevent stress in the ladybirds (Trisyono, pers. com., 2003).
  The relative humidity can be controlled by positioning recipients containing water, and a fan.
  Indeed, ladybirds are particularly sensitive to this aspect.

Lastly, even though unlikely, there may be a genetic problem. A recessive gene is often encountered in small rearing units and a flightless strain ends up being selected.

▪ Management of *C. politus* rearing

To ensure that *C. politus* rearing is carried out correctly, we recommend respecting the following stages (diagrams below)

1. Introduce five pairs for mating and egg-laying,
2. Remove the adults after egg-laying, i.e. after 10 days,
3. After 5 days, transfer the young second instar larvae (with an artist's paintbrush) to a new infected pumpkin,
4. The first adults are obtained a fortnight later.

The temperature and humidity data are given in Annex 3.
It is essential that a label giving background information be affixed to the front of each cage: introduction date and number of male and female ladybirds in the cage, etc.

5 pairs of *C. politus* / cage

↓ 10 days

Eggs begin to hatch into L1

↓ 5 days → **Remove adults**

Larval instar L2

↓ 10 days → Transfer

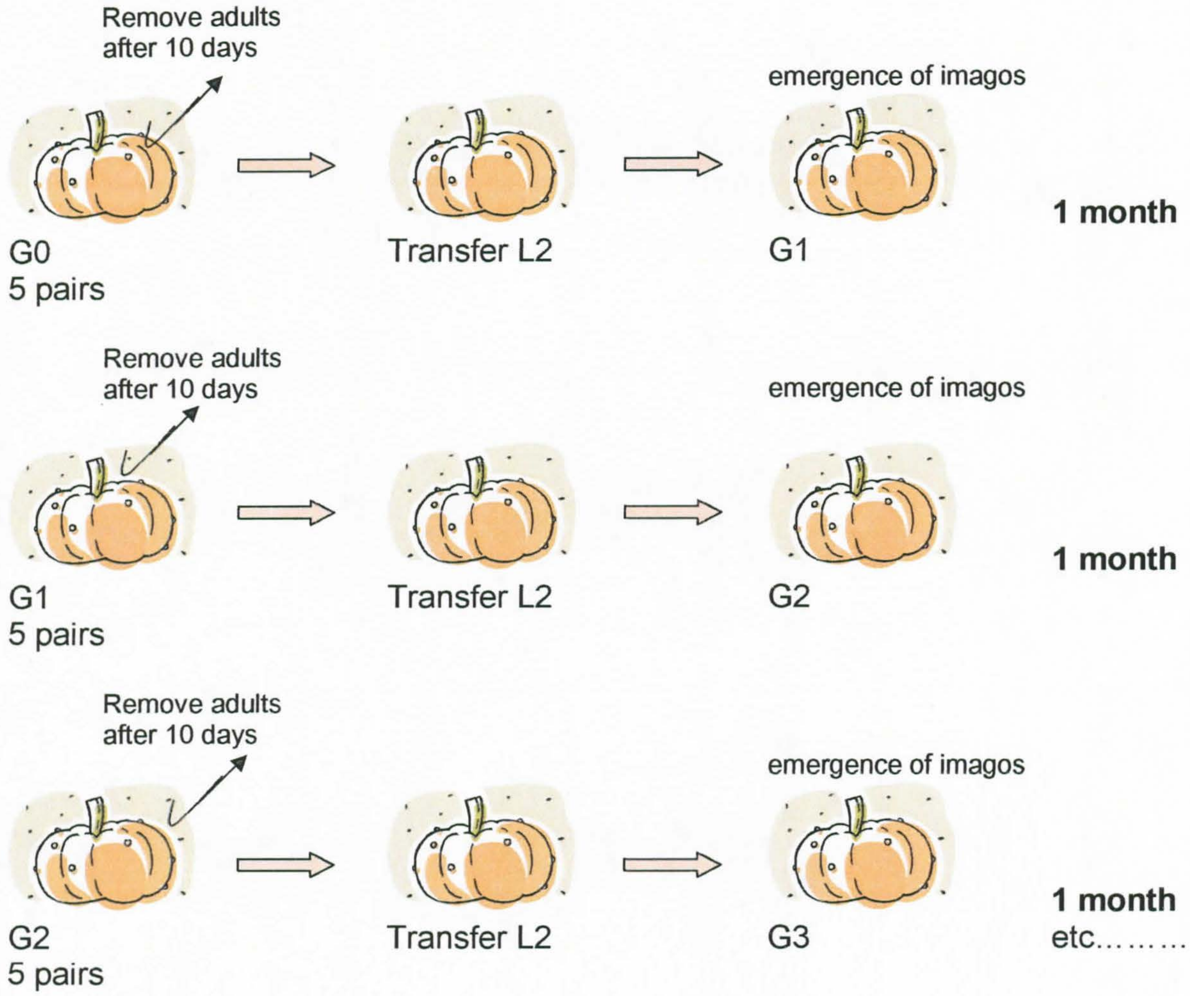
Pupa (do not move)

↓ 5 days

Imagos (1st generation = G1)

→ Transfer

Diagrammatic representation of mass rearing over several generations:



The individuals produced in each generation are available for releases.
It only takes 5 pairs per cage to maintain rearing in ten or so cages.

▪ Useful precautions:
C. politus imagos should be removed as soon as they emerge, so that they do not lay eggs again on the pumpkin on which they developed, and there is no mixing of immature development stages.

Once egg-laying is complete, larvae should be transferred at the L2 stage to a pumpkin infected beforehand by *A. destructor*.

It is essential to isolate all 4 legs of the cages from ants in Petri dishes filled with water. Ants associated with scale insects can prevent ladybirds from becoming established.

UNDER NO CIRCUMSTANCES can *C. politus* be raised on coconut fronds taken from the field, as they dry out and the different instars do not feed properly, which affects adult fecundity. Consequently, *C. politus* is affected and optimum rearing conditions are not achieved. This is why pumpkins or water melons (maybe potatoes) are ideal substitute plants for *A. destructor* and *C. politus* rearing. This technique is widely used (Sadakathulla, 1993).

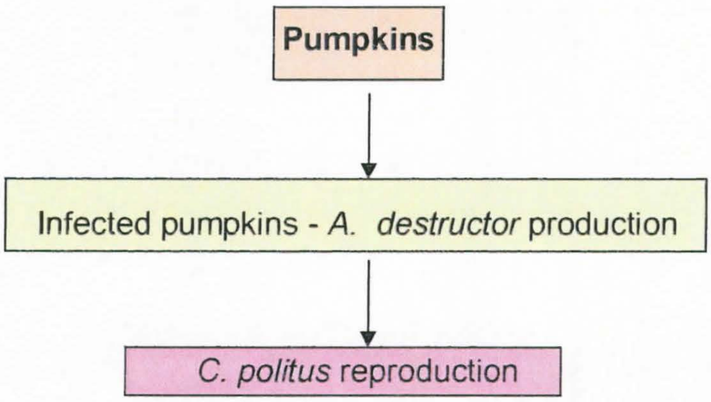
▪ Organization of observations and data:

- Record laboratory data in a logbook intended for that purpose
- Keep both laboratory and field data
- Pass on the data for analysis and interpretation, so that the programme can be reoriented or modifications can be proposed depending on field reality and possible incidents.
- Determining the sex of the ladybirds under a binocular loupe needs to be mastered.

4- Work timetable and protocols

4.1. Successful mass rearing of *C. politus*

This timetable largely depends on the success and the strictness with which a certain number of the above-mentioned operations are carried out, particularly the operation to produce a large number of ladybirds, which consequently requires prior availability of a large enough number of host plants for the feeding and reproduction of *A. destructor,* which is itself essential for ladybird multiplication.



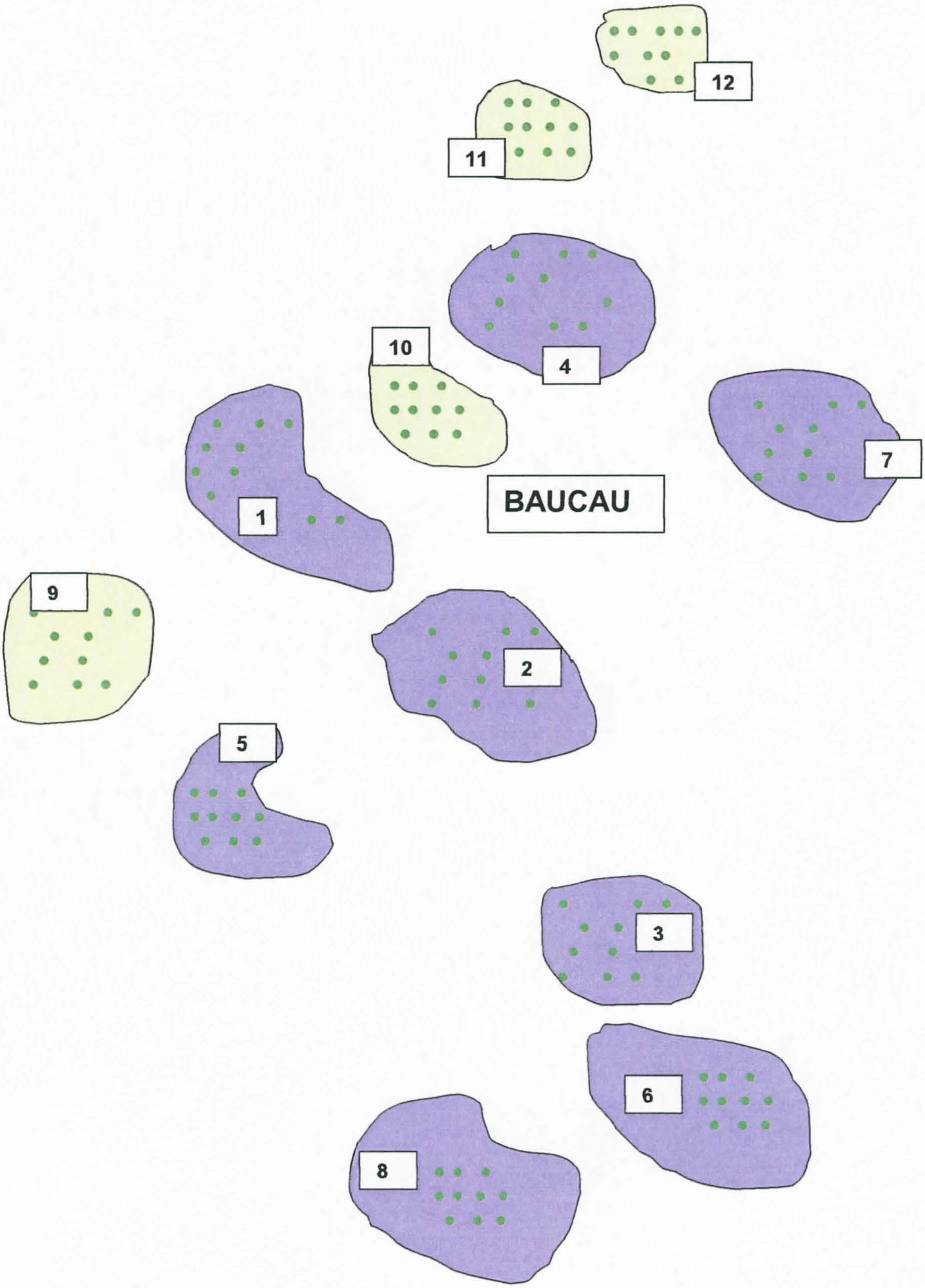
Under the optimum conditions indicated above, ladybird production ought to be optimum by the end of March 2004, with production estimated at 150-200 ladybirds per week (Desmier de Chenon, 2001).
Under these conditions, the first releases could be considered in April 2004, after the rainy season, based on the scheme proposed in Annex 4.

4.2. Estimation of the pest population level prior to the releases

So as to assess the impact of the releases, it is important to know more precisely than just visible appearance, how large the pest population is **before any human intervention** (biological control and introduction of enemies).
It is therefore **ESSENTIAL** to carry out this assessment **before the first release operation**, in the first quarter of 2004 (Annex 4).

▪ Protocol
This study is to be carried out at the eight sites where the releases are to take place, but also at four separate sites where no releases will be carried out (described in § 4.3). These 4 sites will serve as the control to study *C. politus* dispersal in the wild (Figure 32 and Annex 1).

Fig. 32: Diagram of the sites and counts



Key : Release sites numbered 1 to 8

Control sites without releases numbered 9 to 12

Indicates a coconut palm, i.e. 10 palms per site

A protocol is proposed in Annex 5. It consists in counting *A. destructor* adult colonies to assess their number per unit area.

On each coconut palm, 3 infected horizontal fronds will be selected on which one sample measuring 100 x 20 mm will be taken per leaflet to count the number of *A. destructor* adults on three 1 cm^2 samples (Figures 32 and 33).

Under a binocular loupe, adult individuals inside each of the 3 squares will be counted and recorded in the table provided for that purpose (Annex 6).

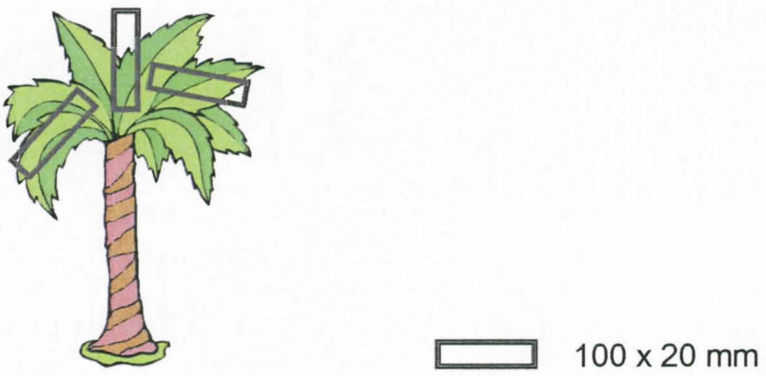


Fig. 33: Samples taken on a coconut palm

The operation should be repeated on 10 coconut palms per site (i.e. 30 samples), at the 12 selected sites.

▪ Data processing

These data will be used as the control.

The raw data should be sent to CIRAD for future analyses and interpretations.

Generally speaking, we ask that data be sent to us regularly (once a month) by e-mail.

It will then be possible to determine the level of infestation, i.e. the number of *A. destructor* per unit area per locality, in space and time. In fact, these data will be compared to the data measured 6 months, 12 months and 24 months **after the first releases** in order to estimate the effect of *C. politus* .

4.3. Organization of releases in the wild

4.3.1. Identification and description of release sites

▪ Release sites

During our mission, **eight sites** were selected with our partners for the future releases, based on their location in relation to the infestation focus and on the infestation limit zones we observed.

These sites will be observed for the *A. destructor* population level **before** (§ 4.2.) **and after the releases**, for the *C. politus* population levels after releases depending on time, and for changes in the phytosanitary condition of the coconut palms over time, i.e. 6, 18 and 24 months after the releases.

The 8 sites are located in the Baucau zone infected by *A. destructor* (Annex 1 and Figure 34).

The sites selected for releases are indicated by a purple disc on the map (Annex 1). There are 8 of them. Site No. 1 corresponds to the initial *A. destructor* focus, where the first damage was seen, and where palms are currently dying. Site No. 8 is the furthest site from the initial focus and is a zone where there is less damage.

Site No.	Location	Direction from Baucau	Site characteristics
1	Waïneke	N – W	Existence of infected palms
2	Teolake	N – W	Ecosystem enabling the ladybirds to find shelter during the
3	Diwake	N – W	hot periods of the day.
4	Kelapa	N	Environment with no human activity that can affect *C. politus*
5	Uaineque	N – W	development.
6	Power supply	S	
7	Kasmutu	N – E	
8	Lutumutu	S	

Fig. 34: Identification of the 8 sites proposed for *C. politus* releases

- Control sites

These are indicated by yellow discs on the map (Annex 1) and are identified in Figure 35.

Site No.	Location	Direction from Baucau	Site characteristics
1	Outskirts of Uaineque	W	Existence of infected coconut palms.
2	Teolale	N	Agroforestry zones.
3	Dïwake	N	Intercropping.
4	Uatabo (beach)	N	

Fig. 35: Identification of the 4 sites proposed as controls for assessing *C. politus* dispersal

GPS records of the release sites will have to be kept and aspects characterizing the ecosystem will have to be recorded (vegetation, height above sea level, slope, hydrography, etc.).

4.3.2. Number of insects to be released

The minimum number of insects to be released per site is estimated at 100 imagos and ideally 200 to 300 individuals (ACIAR, 1991).
Releases can be staggered in time:

Example :

Site	Number of *C. politus* imagos released			
	April	May	June	July
1	120			
2	120			
3		140		
4		130		
5		110		
6		110		
7			150	
8			200	

Depending on *C. politus* production in the laboratory, and as an indication, the timetable for releases and inspections could be as described in Annex 4.

4.3.3. Release conditions (time of year, of day, pitfalls to be avoided, etc.)

Releases will have to be made under strict conditions:

- <u>suitable weather</u>: *C. politus* can in no way be released
    - if it is raining
    - during the hottest hours of the day
    - if it is windy.

- <u>appropriate environmental conditions</u>: *C. politus* cannot be released near a fire, floods, where undergrowth is being cleared, after insecticide or herbicide treatment, etc.

It is essential that the sites have shady areas.
Care should also be taken to ensure that the ladybirds are protected from ants at the release sites, and from other predators, taking care to check that the actual release sites do not have any.

▪ <u>At a site</u>
Releases at a given site can take place on one and the same palm with the following characteristics:

- a palm from which all the lower dry fronds have been removed,
- a palm that is not disturbed (nearby dwellings, children playing with machetes, fires, etc.).

Check that the ladybirds can fly.

▪ <u>Release method</u>
The sample of 100 ladybirds can be distributed in small cages from which they can escape naturally, so as to gradually adapt to their new surroundings and gradually move into the palm crown. The cages could consist of:

* Koppert type "Biological system" flasks (125 cc), hung from the underside of fronds, that can contain 25 individuals, and which are used for *Crytolaemus montrouzieri.*

* 70 x 70 mm cages made with muslin that is starched to maintain the structure, with one open end to allow the ladybirds to escape into the wild.

Climatic data should be recorded throughout the releases, notably rainfall, which can be a factor that affects *C. politus* development in the field.

<u>4.4. Estimation of the pest population level after the releases – Study of release impact</u>

The first assessment of the *A. destructor* population level will be made 6 months after the first release (Annex 4). The second assessment will be made 12 months after the first release and, lastly, the third will be made after 24 months.

4.4.1. Census 6, 12 and 24 months after the releases

4.4.1.1. Aspidiotus destructor

The number of scale insects per unit area will be assessed using exactly the same protocol as that described in § 4.2. for evaluating the level of *A. destructor* populations BEFORE the first release (Annex 5).

These data will be used to assess the efficiency of releases and their impact on reducing *A. destructor* damage.

Two hypotheses:
- the *A. destructor* population level decreases, and thereby damage too,
- the *A. destructor* population level remains the same and damage remains economically unacceptable.

4.4.1.2. Chilocorus politus

The *C. politus* ladybird population released into the wild will be monitored in time and space 6 months, 12 months and 24 months after the different releases. Imagos and larvae will be counted at the 8 release sites and 4 control sites. A record sheet can be drawn up and sent on request.

These data offer the advantage of indicating whether:
- the ladybirds have survived in the days or months following the releases,
- the ladybirds have been able to reproduce and develop in the ecosystems into which they have been released,
- the ladybirds are capable of colonizing other sites, if they are found for example at the 4 control sites.

4.4.2. Results

Acclimatization of the biological control agent:
The first sign that a biological control agent has become acclimatized is to find a progeny, but if reproduction is observed for a year and at least 2 generations in the field beforehand, acclimatization can be considered as likely.

If the ladybirds disperse enough in the first year, and thereby occupy a certain diversity of micro-habitats, the chances of acclimatization success are good. However, it may take several years for the population to increase in number and disperse enough to show a positive effect in reducing damage caused by the pest insect.

A. destructor sampling needs to be carried out regularly, as indicated in section 4.4.1. above, to study ladybird dispersal. If the ladybirds do not seem to be very mobile, it would be best to disperse them from individuals kept in the rearing unit.

Impact
The density of the pest *A. destructor* will be studied at selected sites on identified coconut palms (§ 4.2 and §4.3.1.)
To measure this impact, it is **STRICTLY FORBIDDEN to use chemicals in the zone where the ladybirds are to be released and in the neighbouring zones they might colonize.**

5. Particular case of *Pullus* sp. (Coccinellidae Scymnini)

As mentioned in § 2.1., a species of Coccinellidae has been observed several times on coconut palms at the port of Com. It may be *Pullus* sp. (Gourreau, 1974).
Several examples were brought back to the Triloka laboratory for appetency tests on samples of fresh coconut leaflets infected by *A. destructor* (Figure 36).

Fig. 36: Appetency tests on *Pullus* sp. in the Triloka laboratory

1.1. <u>Merits</u>

This ladybird is naturally present in Timor-Leste, and it is very important to test whether it is a predator on the coconut scale *A. destructor*.

1.2. <u>Recommendations</u>

It is therefore **strongly** recommended that some laboratory work be devoted to testing the activity of this ladybird and to launching rearing operations if it is capable of reproducing on *A. destructor*.
Indeed, if this ladybird is efficient, and if rearing operations are carried out properly, releasing it could strengthen any action by *C. politus* in the field, which has yet to be demonstrated.

III- CONCLUSIONS: CONDITIONS FOR A SUCCESSFUL OPERATION

1. Conscientiousness

As already mentioned, it is necessary to work regularly and to take care not to skip any stages, respecting the rules already defined.

This will also mean acquiring some basic laboratory and field equipment, such as:
- a field magnifying glass
- binocular loupe + cold light source
- artist's paintbrushes
- tweezers
- pencils and marker pens
- laboratory logbooks x 5
- pins
- elastic bands

- sealed plastic boxes
- muslin
- shelving
- tapemeasure
- mouth aspirator
- electronic thermometer/ hygrometer
- GPS

Garden: production of host plants (pumpkins, water melons, potatoes) .

2. Scientific and technical supervision

We propose that Dr. Andi Trisyono carry out a support mission in 2004 to take stock of activities and assess ongoing operations in the laboratory and in the field, and so that he can provide advice and recommendations for furthering the operations. This mission could be backed up at the beginning of 2005 with a mission by the CIRAD experts.

3. Financial support

Following our visit to the European Commission office in Dilu, we sent G. Colombo our March 2002 mission report, so that he could familiarize himself with our involvement in this operation.

Given the end of USAID support at the end of 2003, we estimated the cost of the biological control programme over 3 years, a programme which includes the programme of releases over several months, continuous *A. destructor* and *C. politus* production under controlled conditions, but also and especially a study on the impact of these releases and an assessment of C. *politus* acclimatization in the field for **sustainable** control of *A. destructor* development (Figure 37).

Fig. 37: Budget proposal – 3 years – 2004-2006

Item	Estimation (€)
Staff	
2 laboratory and field technicians	18,000
1 security guard	6,000
Training	1,900
2 UGM/INRA/CIRAD training courses	
Permanent equipment	2,300
1 binocular loupe +	
1 binocular loupe light source	2,000
2 motorbikes+petrol+maintenance	
2 bamboo/muslin insectariums	500
GPS	400
Laptop computer	2,300
Mobile phone – 3-year contract	800
Consumables	
Plastic boxes	80
Muslin	50
Elastic bands	8
Pins	4
Wooden shelves	155
Tweezers +artist's paintbrushes	30
Tapemeasure	4
Mouth aspirator	8
Electronic thermometer/hygrometer	55
Laboratory logbooks	30
Marker pens, felt pens, labels, scissors	45
Tubes	60
Generator fuel	760
Muslin for lab windows	300
Miscellaneous	
Garden (production of pumpkins, etc.) +	80
Garden tools	
Cage/laboratory upkeep	760
Scientific and technical support	
Annual visit (2 experts) x 3	79,000
Final meeting	167
Extension, information	
Farmers meetings	2,500
Posters	900
Conference papers + Publications	15,200
Miscellanous/Unforeseens	760
Photocopies	150
E-mail connection	150
SUB-TOTAL	135,456
+ 10%	13,545
TOTAL	**149,000**

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Annexe 1

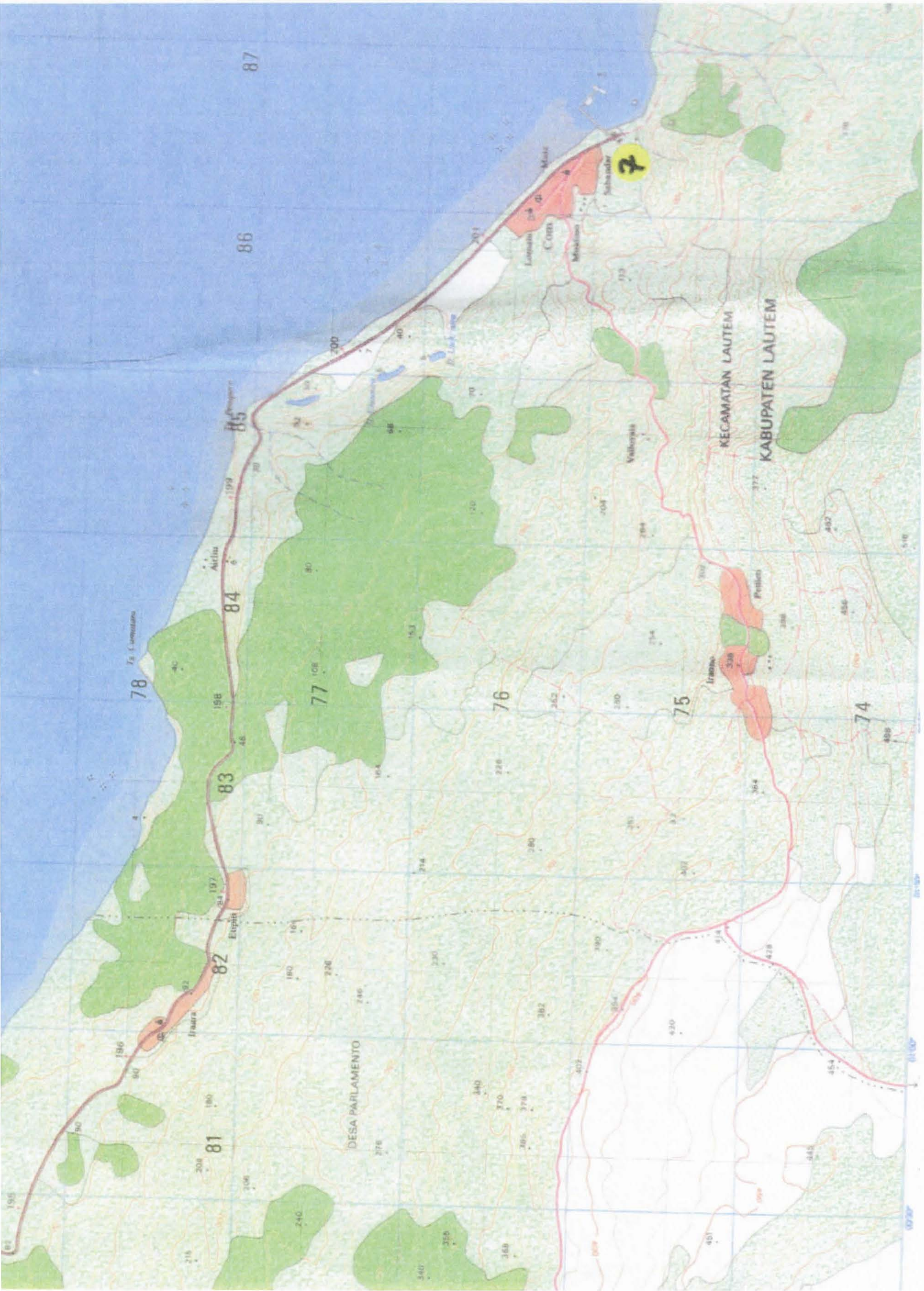
Limite d'infestation d'*A.destructor*

Sites témoins (N° 1 à 4)

Sites de lâchers (N° 1 à 8)

Dégâts importants en 12/2003, contrairement à 02/2002

Annexe 2



Dégâts au port de Com (District de Baucau)

MASS REARING Chilocorus politus CLIMATIC CONDITIONS (BAUCAU) **Annexe 3**

	NIGHT									DAYTIME		
	07.00			07.00		12.00		17.00		17.00		
Date	Min	Max	R	T°	RH	T°	RH	T°	RH	Min	Max	R
1												
2												
3												
4												
5												
6												
7												
8												
9												
10												
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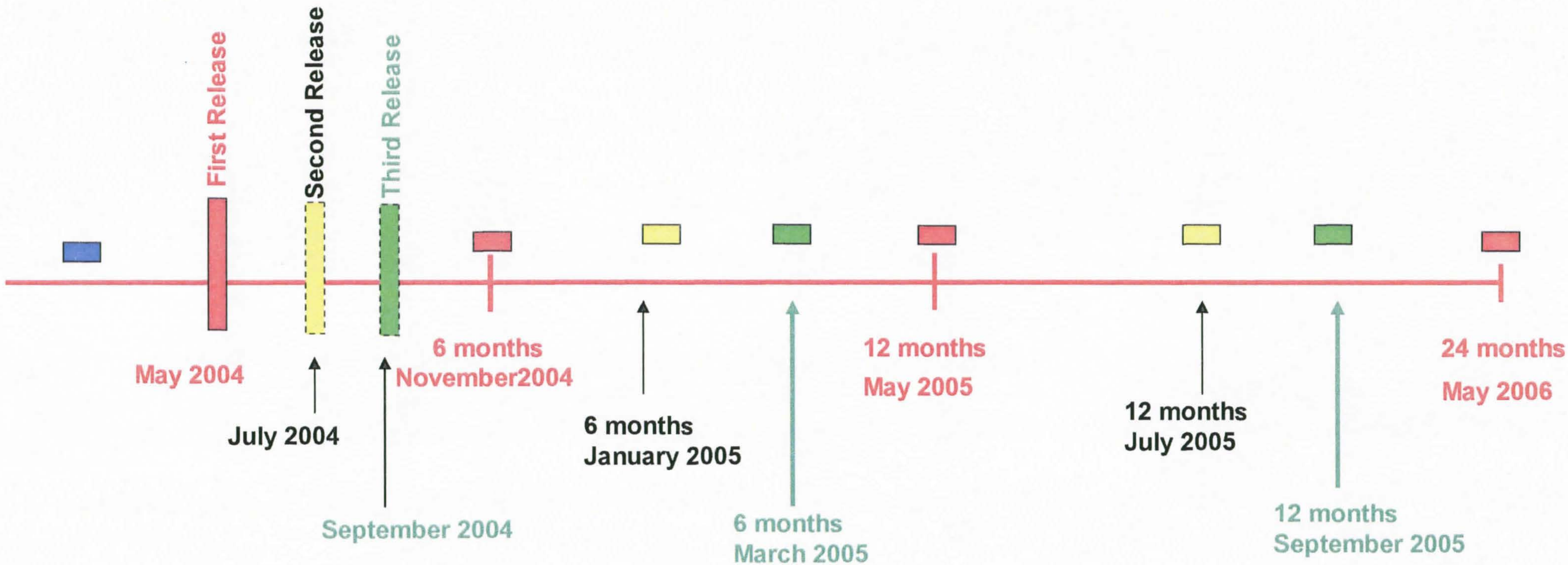
repared by Dr. L.Ollivier et Dr. X.Bonneau 12-12-2003

SCHEDULE PROPOSAL FOR 2004 to 2006

ATTEMPT OF BIOLOGICAL CONTROL AGAINST *ASPIDIOTUS DESTRUCTOR* IN EAST TIMOR (BAUCAU DISTRICT)

RELEASE, ESTABLISHMENT AND DISPERSION OF THE PREDATOR *CHILOCORUS POLITUS*.



ANNEXE 4

Dynamic population survey in the 12 selected sites. Survey of establishement and dispersion of *C. politus*.

Release period depending of *Chilocorus politus* mass rearing success (at least 300 adults available) :
100 or plus adults to be release per site. 3 sites might be treated.

Prepared by Dr. L. Ollivier et Dr. X. Bonneau **12-12-2003**

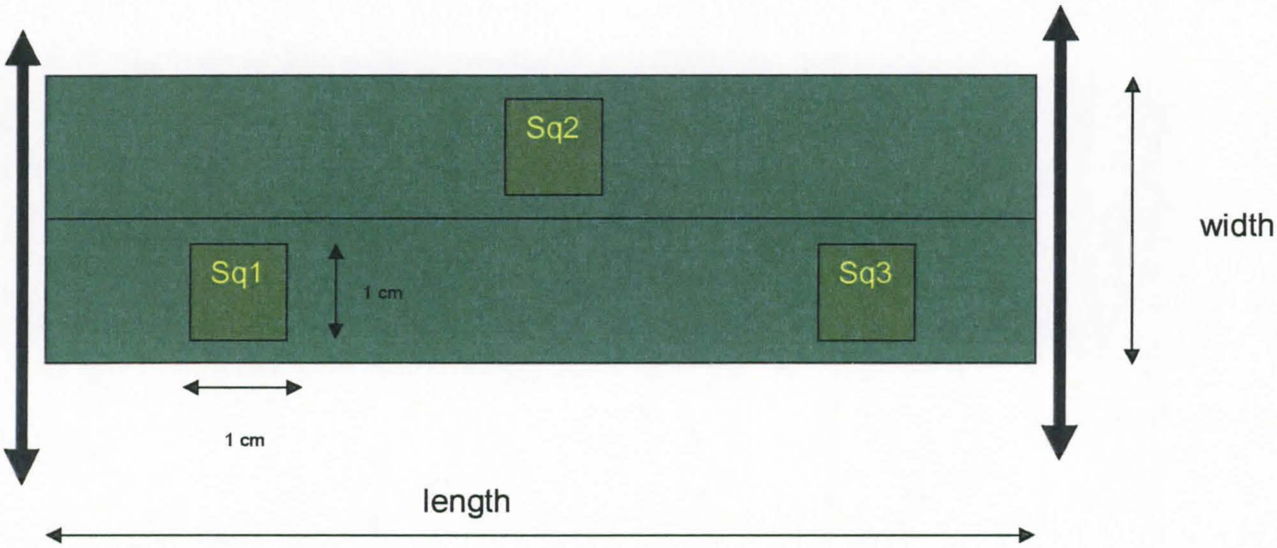
Populations dynamic of *Aspidiotus destructor* in Baucau

ANNEXE 5

In each site of future release: 8
In each site distant from the release sites : 4

Sampling : 10 trees per site (1 to 10).
3 leaflets per tree (Leaflet 1, Leaflet 2, Leaflet 3).

Date : 1 time between January and April 2004.



Counting square = 1 cm2

__Results__ : To be send to CIRAD for analysis. (Table under Excel is attached).

E-mail : Laurence.ollivier@ cirad.fr

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Mail : CIRAD-CP

TA 80/02

Avenue Agropolis

34398 Montpellier cedex 5

France

POPULATION LEVELSURVEY OF ASPIDIOTUS DESTRUCTOR

By Dr Ollivier et Dr. X. Bonneau (Cirad)

SITE 1 Date:

ANNEXE 6

N° trees	Leaflet 1								Leaflet 2								Leaflet 3							
	length	width	Sq 1	Sq 2	Sq3	x	Total area	nb Ad/area unit	length	width	Sq 1	Sq 2	Sq3	x	Total area	nb Ad/area unit	length	width	Sq 1	Sq 2	Sq3	x	Total area	nb Ad/area unit
1							0,00	#DIV/0!							0,00	#DIV/0!							0,00	#DIV/0!
2							0,00	#DIV/0!							0,00	#DIV/0!							0,00	#DIV/0!
3							0,00	#DIV/0!							0,00	#DIV/0!							0,00	#DIV/0!
4							0,00	#DIV/0!							0,00	#DIV/0!							0,00	#DIV/0!
5							0,00	#DIV/0!							0,00	#DIV/0!							0,00	#DIV/0!
6							0,00	#DIV/0!							0,00	#DIV/0!							0,00	#DIV/0!
7							0,00	#DIV/0!							0,00	#DIV/0!							0,00	#DIV/0!
8							0,00	#DIV/0!							0,00	#DIV/0!							0,00	#DIV/0!
9							0,00	#DIV/0!							0,00	#DIV/0!							0,00	#DIV/0!
10							0,00	#DIV/0!							0,00	#DIV/0!							0,00	#DIV/0!
Moy	#####	#####	#####	#####	#####	####	0,00	#DIV/0!	#DIV/0!	#####	####	####	####	####	0,00	#DIV/0!	#####	####	####	####	####	#####	0,00	#DIV/0!

SITE 2 Date:

N° trees	Leaflet 1								Leaflet 2								Leaflet 3							
	length	width	Sq 1	Sq 2	Sq3	x	Total area	nb Ad/area unit	length	width	Sq 1	Sq 2	Sq3	x	Total area	nb Ad/area unit	length	width	Sq 1	Sq 2	Sq3	x	Total area	nb Ad/area unit
1							0,00	#DIV/0!							0,00	#DIV/0!							0,00	#DIV/0!
2							0,00	#DIV/0!							0,00	#DIV/0!							0,00	#DIV/0!
3							0,00	#DIV/0!							0,00	#DIV/0!							0,00	#DIV/0!
4							0,00	#DIV/0!							0,00	#DIV/0!							0,00	#DIV/0!
5							0,00	#DIV/0!							0,00	#DIV/0!							0,00	#DIV/0!
6							0,00	#DIV/0!							0,00	#DIV/0!							0,00	#DIV/0!
7							0,00	#DIV/0!							0,00	#DIV/0!							0,00	#DIV/0!
8							0,00	#DIV/0!							0,00	#DIV/0!							0,00	#DIV/0!
9							0,00	#DIV/0!							0,00	#DIV/0!							0,00	#DIV/0!
10							0,00	#DIV/0!							0,00	#DIV/0!							0,00	#DIV/0!
Moy	#####	#####	#####	#####	#####	####	0,00	#DIV/0!	#DIV/0!	#####	####	####	####	####	0,00	#DIV/0!	#####	####	####	####	####	#####	0,00	#DIV/0!